Outline of the Ph.D. Work

"Synthesis and Characterization of Nanocomposite thin films of ZnO-Polypyrole for Gas sensing applications"

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by

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Introduction:

Rapidly increasing environmental pollution has been recognized as a major concern, and its monitoring has become a priority area for researchers. This fact has led efforts to find new and user-friendly techniques for the detection of gases hazardous to human health. Gas sensors have become one of the key technologies for rapid, selective, sensitive, and efficient detection of gases, chemical vapors and explosives. The field of gas sensing device development remains an area of active research interest due to the urgent need for reliable, miniaturized, low-cost, and portable sensing systems for health care. Gas sensors based on organic conducting polymers such as Polypyrrole (PPy) of desired functionality and conductivity continue to improve gas sensing performance, however, due to the high afinity of conducting polymers toward moisture present in the environment, they are sometimes unstable and exhibit poor sensitivity. On the other hand, gas sensors made from inorganic metal oxides, such as Zinc oxide (ZnO) may show improved sensing characteristics due to changing oxygen stiochiometry and electrically active surface charge, however, these gas sensors usually operate at very high temperatures, in spite of the high sensitivity, the use of such gas sensors has some restrictions. Issues related to low conductivity and poor stability of ZnO materials, the high-temperature operation and complicated processability of inorganic materials, hinder their use in gas sensor fabrication. The use of hybrid nanocomposites of these two classes of materials may result in gas sensors with improved and efficient LPG sensing characteristics.

Hence the present work focuses on the ZnO nanoparticles synthesis and formation of ZnO nanoparticles incorporated nanocomposite Polypyrrole thin films and its physicochemical and optoelectronic characterization.

Objective:

The nanocomposite thin films of Polypyrrole/ZnO will be synthesized either by Solution Polymerization or electro-polymerization technique over substrate surface. The synthesized film will be characterized for Structural, Morphological, Optical, and Electrical Properties. The same will be tested as a LPG sensor on optimizing the synthesis parameters for obtaining Selective, Sensitive, lower temperature operating LPG sensor.

Work plan and methodology:

Synthesis:

The ZnO nanoparticles will be deposited either ultrasonication or simple chemical route, these prepared nanoparticles will be then directly poured in the chemical ingredient containing flask to obtain ZnO intercalated nanocomposite Polypyrrole thin film. These as prepared thin films will be characterized for physicochemical and opto-electronic properties in particular LPG sensing.

Characterization:

Film Thickness:

Film thickness will be measured either by using Gravimetric Weight Difference Method or Spectrophotometric Method.

Structural and Morphology:

The structural and morphological characterization of the synthesized thin film will be using

1. X-ray Diffractogram (XRD),
2. Scanning Electron Microscopy (SEM),
3. Energy Dispersive Analysis by X-ray (EDAX)
4. Transmission Electron Microscopy (TEM),
5. Selected Area Diffraction Pattern (SAD)

Optical Study:

The optical characterization will be performed for the Absorbance, and subsequently for energy band gap calculations using UV-Vis Spectrophotometer, Raman spectra and FTIR.

Electrical Characterization:

The electrical characterization such as conductivity, Hall-effect will be calculated for confirming the electrical properties.

Gas Sensor:

LPG Gas Sensing will be performed under an ambient condition for calculating the response, recovery time, selectivity and sensitivity on either assembled gas sensor or else Optical response sensor.

Future Scope of the work:

Now a day the complete world is scaring about the major problem of Global Warming caused by the liberation of harmful gases through different activities. If all the countries will follow the resolution of United Nation about the liberation of such environment destructing gases (% fixed by UN to each country for such gases liberation) then the problem of Global Warming will automatically solved. Now to keep tab on such unwanted liberation of LPG everyone must keep watch on extent of LPG liberated to environment and hence for such monitoring Gas sensor can be used. Also the Gas sensor can be used as a house hold instrument, in transportation mode, residencies, hotels, industries, Hospital, and Educational Institutes etc.

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